Improving Habitability, Mood & Diet through Bioregenerative Food Systems

Completed Technology Project (2012 - 2017)

Project Introduction

During spaceflight, mealtime plays a primary role in psychological well-being of the crew by contributing to stress reduction, boredom relief and group unity. During long duration exploration missions, vegetarian diets will be adopted, creating a challenge to meet the psychological need for dietary variety. Growing edible plants provides nutritional benefits and enhances variety and composition of food. Currently, pre-packaged food is the foundation of the astronauts food system and the capability to supply fresh foods is very limited. Bioregenerative Food Systems will provide the necessary nutrients needed for the astronauts survival and will enhance the psychological well-being of the crew. One cause of nutritional deficiencies in astronauts and the consequential health effects is inadequate food intake. This can be partially attributed to the effects of spaceflight on appetite, operational constraints and food acceptability. Growing fresh foods will enhance habitability and diet including: nutrition, food acceptability, dining experience and crew mood. The prevention of crew performance decrement and illness due to inadequate food systems can be accomplished with a Bioregenerative Food System. Astronauts have reported that caring for plants is an enjoyable activity. Plants also provide an important link to Earth, exploiting the sensory enrichment of nature to contrast the stark and sterile machine environment typical of space habitats. It is hypothesized that Bioregenerative Food Systems provide a double benefit to the crews well-being both through consumption of fresh foods and through Human-Plant Interactions. The first component of my research investigates the health benefits and human factors involved in food production and which Human-Plant Interactions the crew enjoys and benefits from the most. This will provide a better understanding of which tasks should be automated and how automation can reduce the workload for undesirable tasks. The second component involves developing growth automation strategies achieved through robotics and computer data processing. I will conduct some of these experiments using a commercial AeroGarden system that has different levels of automation. Modifications will be made to the AeroGarden to enhance its automation capabilities using robotic and sensing platforms being developed collaboratively at the University of Colorado at Boulder. The automation strategies will involve studying Human-Computer Interactions and Human-Robotic Interactions to optimize the use of crew time, vehicle resources and to increase food production reliability and self-sufficiency. The third component of my research will investigate the integration of Bioregenerative Food Systems into the space habitat to improve habitability and to minimize habitat resource utilization. My research findings will influence future space habitat architecture. The determination of crew health benefits from direct Bioregenerative Food System integration into the habitat (opposed to separate growth chambers) and how automation can positively contribute to a robust food system is a pinnacle technical development needed to extend the human presence into the solar system. Additionally, my proposed research of Bioregenerative Food Systems is aligned with research that NASA has identified as part of the critical path for long

Project Image Improving Habitability, Mood & Diet through Bioregenerative Food Systems

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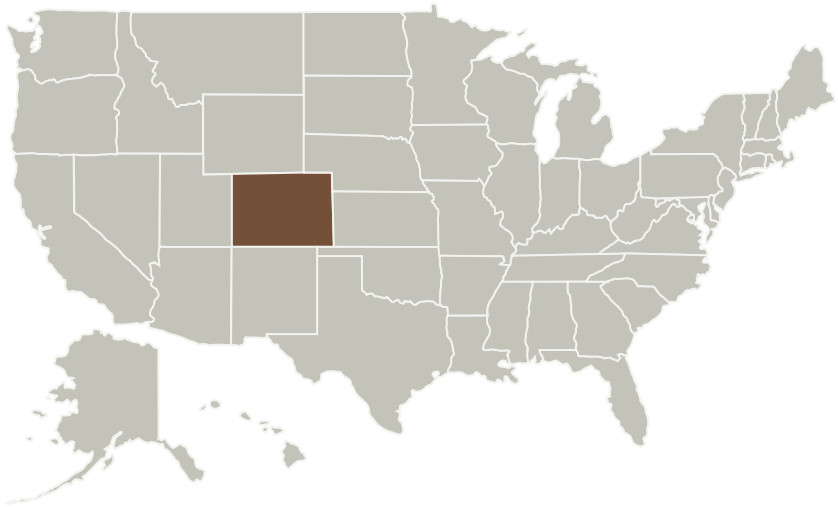
duration human space exploration.

Anticipated Benefits

My research findings will influence future space habitat architecture. The determination of crew health benefits from direct Bioregenerative Food System integration into the habitat (opposed to separate growth chambers) and how automation can positively contribute to a robust food system is a pinnacle technical development needed to extend the human presence into the solar system. Additionally, my proposed research of Bioregenerative Food Systems is aligned with research that NASA has identified as part of the critical path for long duration human space exploration.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of Colorado Boulder	Lead Organization	Academia	Boulder, Colorado

Primary U.S. Work Locations
Colorado

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

University of Colorado Boulder

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

Nikolaus Correll

Co-Investigator:

Heather M Hava

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Images

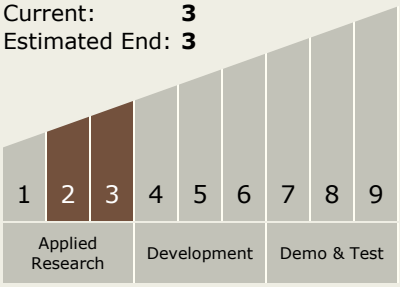
11493-1363186410779.jpg
Project Image Improving Habitability, Mood & Diet through Bioregenerative Food Systems
(https://techport.nasa.gov/image/1780)

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.6 Human Systems Integration
    - TX06.6.3 Habitability and Environment

Target Destinations

Earth, The Moon, Mars